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ecosystem fragmentation: An Australian perspective. *Ekistics*, 59, 353/354, pp. 21-28.

Murphy D.D. & B.R. Noon, 1992. Integrating scientific methods with habitat conservation planning: Reserve design for northern spotted owls. *Ecological Applications*, 2(1), pp. 3-17.

Myers N., 1990. The Biodiversity Challenge: Expanded hotspot analysis. *The Environmentalist*, 10(4), 243-256.

Soulé M., 1987. Viable populations for conservation. Cambridge University Press, Cambridge, 189 p.

Tilman D., 1982. Resource competition and community structure. Princeton University Press, Princeton, 237 p.

Ecological networks in Danish planning

Jesper Brandt

The purpose of this paper is to give a short presentation of the relatively long tradition for planning of ecological networks in Danish regional planning, and to relate this tradition to the development of Danish conservation policy. It states that although many plans for ecological networks have been made, hardly any have been implemented. At the same time, the plans lack a formal link with physical planning in general, and with nature conservation policy in particular.

Introduction

Ecological networks are related to different levels. Basically, one can distinguish between international, national, regional and local ecological networks. They are in their content and way of planning and implementation so different that one can postulate that the only thing they have in common are some very general concepts related to spatial interaction. On the other hand, it is obvious, at least from a theoretical point of view, that ecological networks on the different levels should be linked together in a hierarchical approach: since our landscapes are hierarchical organised, ecological networks should correspond to this fact. In practical planning today, however, this is far from being the case, although in the last 10 years ecological net-

works have been among the most popular themes in physical planning in many developed countries.

An hierarchical approach to ecological network planning has been well-known and discussed by Danish conservation planners since the beginning of the 1980s (Agger & Brandt, 1984). It has however not been systematically implemented in Denmark. The planning has been concentrated on two different levels, namely the international and the regional.

At the international level, many important habitats for migrating birds have been designated, related to the Ramsar- and EU Bird Directives, and now also designated according to the Habitat Directive. At the national level, there has been very little (if any) systematic planning of ecological corridors. But implicit priorities have been given to coastal landscapes and river valleys in the national planning and designation of landscapes.

At the regional level, ecological corridors have been strongly recommended by the Ministry of Environment, and have been developed as a more or less important part of conservation planning during the last 10-15 years in the majority of the Danish counties. This has been done in a very decentralized manner, leaving room for a variety of planning concepts and practical applications in the different counties. Since the counties are responsible for the integrated countryside planning, other types of sector planning legislation (such as the Agricultural Holdings Act, the For-

Ecological networks

Regional planning

Conservation policy

Denmark

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est Act and especially the Watercourse Act) have had an indirect influence on this process, too. This influence is expected to grow in the future, since in the last years revisions of these acts have emphasized a broader environmental and landscape perspective. For example, the 1982 Watercourse Act stipulates that the traditional maintenance of watercourses for hydraulic reasons now must take into consideration environmental objectives for the quality of the watercourses (Miljøstyrelsen, 1994). The purpose of the 1986 Agricultural Holding Act has been widened to cover also the landscape and environmental values of agricultural areas. The 1989 Forest law emphasizes the multiple use of forests. Finally, the 1992 Nature Protection Act has gathered and strengthened earlier legislation to protect and restore nature, as well as to improve public access to nature areas. Corresponding to this, the new (1992) Spatial Planning law has done away with the former compulsory sector planning, thus emphasizing the integrative objectives of regional planning.

At the local level, there has been a growth of practical activities aimed at remedying problems of habitat fragmentation for threatened species, mainly initiated by county authorities. But few plans for local networks have been established, and such local activities have seldom been related to the planned dispersal corridors at the regional level.

The different levels of ecological networks is however only one dimension that produces different concepts: also different historical starting points for the planning of ecological networks exist and influence the planning process.

Three main traditions can be distinguished:

1 A 'greenway' tradition, mainly based on an American landscape-architectural origin dating back to the beginning of this century (Langevelde, 1994; McHarg, 1969).

2 A 'nature conservation' tradition, based

on modern Island Theory and Metapopulation Theory and their implementation in conservation planning (Forman & Godron, 1986; Harms & Opdam, 1990; Opdam, 1991).

3 A 'landscape stabilization' tradition, with roots in geo-ecologically oriented landscape planning, especially in eastern Europe (Mander *et al.*, 1988; Miklos, 1994).

Although in the process of integrated planning at different levels, and especially in the realization of such plans, these different traditions are often merged, one of the viewpoints seems to dominate in most planning initiatives. For example, at the international level, obvious differences occur between the Dutch EECONET initiative, which is striving towards a coherent structure of important habitats within Europe (Bennett (ed.), 1991; Bischoff & Jongman, 1993), and the planning concept of Territorial Systems of Ecological Stability (TSES) (Miklos, 1991a; Miklos, 1991b), which focuses on the stabilizing effects of ecological networks, with emphasis on their importance in the most intensively used cultural landscapes, which lack valuable nature habitats.

The connecting of these different traditions to produce a more holistic and multi-purpose planning and management system of our landscapes can be seen as one of the practical objectives of modern landscape ecology.

The first two viewpoints have dominated the development of ecological network planning in Denmark. However, when it comes to the practical implementation of corridors, the third perspective seems to grow in importance because of the strong influence from general agricultural and environmental policy, especially as related to water protection. For example, the increase in 'connectedness' (Baudry & Merriam, 1988) of uncultivated areas along watercourses is in some ways more a side effect of the barriers set up as buffer zones to prevent the leaching of nutrients than a



• Figure 1
Map of the Danish Counties. Until 1989, regional planning for the three counties within the Greater Copenhagen Area (Frederiksborg Amt, Roskilde Amt, and Copenhagen Amt) was taken care of by The Greater Copenhagen Council, which was dissolved in 1990.

result of corridor planning.

In the following, some examples of the different planning strategies developed in Danish counties (figure 1) will be presented. The reasons for the lack of a national network will be discussed, and some positive arguments will be given for the lack of network planning on a local level, related to the general conservation strategy that has been followed in Denmark for the last 20 years. It will be argued that a national network must be established.

Landscape connection in regional plans from the 1970s

The idea of the planning of landscape connections is very often related to the development of modern island-biogeography, based on the work of MacArthur & Wilson (1967) and the succeeding endeavour to transfer their theory to habitat islands in agricultural landscapes.

From a planning point of view however this is not correct: until the beginning of the 1980s, landscape planning in Denmark was dominated by landscape architects, land surveyors and foresters. Biolo-

gist, inspired by the island-biogeography, were placed in the conservation departments of the counties only from around 1980. The first Danish planning-oriented publication on conservation perspectives in the island-biogeography was published in 1981 (Muus, 1981). However, before that time especially among landscape architects the principle of planning landscape connections was known and had been used for years, although with another purpose (see e.g. Lewis, 1964). Thus in the comments on the 1978 Danish Conservation Act, it was stated that regional planning according to the law among other things should designate 'important landscape bands, e.g. river valleys and forest reaches, that connect a nature area with another or connect a town to a nature area.' (Fredningsstyrelsen, 1979, (p. 51 Comments on the act, column 2614)). Looking at the first regional plans of Denmark, it is also possible to see remnants of this tradition, that later have obviously been renewed and stimulated by the development of the island-biogeography. Already in the 1973 regional plan of the



1. Directives for urban growth

Urban growth is mainly placed within the 'Frederikssund-finger' and along the N-S main transport corridor crossing the urban fingers spreading out from Copenhagen in the SE corner. The areas in the transport corridor along the new urban areas will give priority to industry.

2. Landscape directives

The dotted green areas indicate landscape connections between the areas for urban growth. Yellow-green areas in the transport corridors indicate recreation areas. The grey toned background indicate 'valuable landscapes'.

3. The structure of the new urban society

The map shows diagrammatically how the new urban areas should be divided into smaller urban societies and how the N-S going corridor should be used. The thin dotted arrows show landscape connections crossing the Frederikssund-finger.

After Hovedstadsrådet: Regionalplan 1973.

Figure 2 • Landscape connections and barriers. Regional plan for the Greater Copenhagen Area 1973. The basic nature of a network—to combine connection with separation (Zonneveld, 1994)—is clearly stated, even with different hierarchical levels.

Greater Copenhagen Region, the most important landscape connections are described, and their collision with barriers in the form of main transport corridors are clearly expressed as one of the principal conflicts that have to be solved within the physical planning at the regional level (see figure 2). In fact, the main idea of this plan goes back to the so-called finger plan from 1947, which tried to concentrate urban development along 5 'fingers' spreading out from the 'palm' of Copenhagen, and leaving the areas between the fingers for nature and recreational purposes.

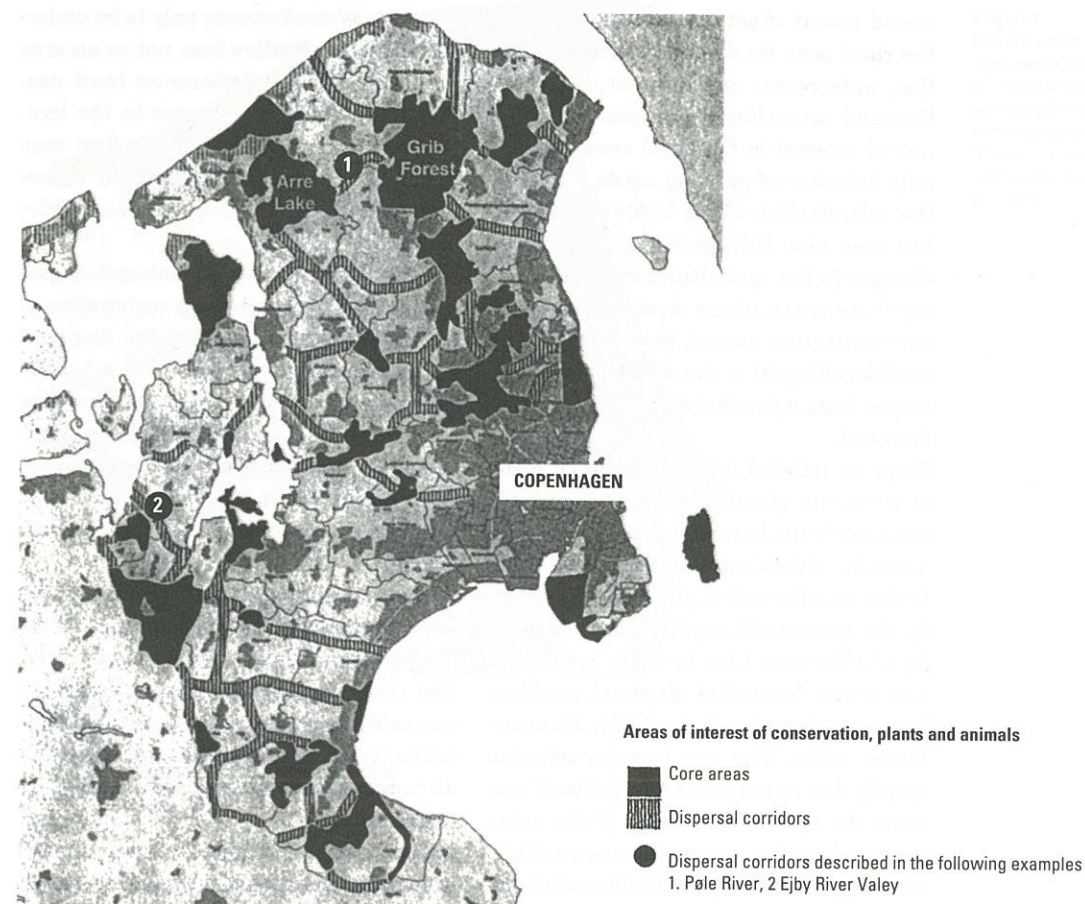
In Funen County, a plan to establish 'areas of connection' between the most important natural habitats and between these and the cities was made in 1976, and implemented unanimously in the 1980 regional plan. Ecological considerations concerning the importance of the areas of connection for preserving and developing a diverse flora and fauna were given, but with no references to dispersal ecology, and only secondary to recreational purposes. Also in other regional or conservation plans from around 1980, indications of such types of

connection can be seen, but generally it has not been explicated in the documents following the plans.

The beginning of ecological-network planning

Ecological planning based on Island biogeography became popular from the beginning of the 1980s. Especially in the Greater Copenhagen Region the concept of dispersal corridors was put into the planning procedure very quickly. Figure 3 shows a proposal for future dispersal corridors in Greater Copenhagen that was put forward in 1982 (Hovedstadsrådet, 1982). This proposal was based on a detailed survey of nature types and comprehensive data registrations of flora and fauna within the region. By superimposing five maps of 1) forests, 2) wetlands, 3) water courses, 4) salt marshes, meadows and heaths, and 5) minor lakes and bogs, 26 core areas were designated. Based on the distribution of flora and fauna outside these areas, main dispersal routes could be indicated as a basis for the designation of dispersal corridors.

This proposal was implemented into the



regional plan from 1985 onwards, and has been confirmed with only very small changes in all later plans.

The corridors are 1 km in width, and mostly situated along water courses with a certain concentration of permanent meadows and other types of wetlands. In some cases also a high concentration of other types of habitats, such as small forests, a high density of hedgerows, and permanent pastures along certain landscape lines could be used for the designation of 'dispersal corridors'. Although the width was originally intended to be adapted to local conditions in a future local planning process, the 1 km zone has however been rather strictly managed in order to prevent conflicts with the owners.

The corridors have had a big influence on

other aspects of integrated planning, for example, the county's agricultural- and water protection planning, where another 500 m was added to each side of the corridor, thus putting restrictions on land use in a considerable part of the rural zone. Due to the intensive consumption of water by the Greater Copenhagen area, the groundwater level has been lowered so much that many watercourses have a critically low water-flow during the summer. Therefore permission for groundwater pumping within this zone has been denied. For the leading urban planners of that time, putting emphasis on the importance of transport corridors as the backbone of regional planning, the idea of corridors for plants and animals was not only understandable and logical, but was also a wel-

• Figure 3 Proposal for core areas and dispersal corridors in the Greater Copenhagen Region from 1983 onwards (Hovedstadsrådet, 1982), here after (Hansen-Møller, 1994). The proposal was adapted with only very few changes by all the following regional plans.

comed means of setting set aside parts of the rural zone for drinking water production, watercourse management, conservation and recreational purposes¹. The renewed interest in the rural zone was not only a matter of growing needs following the urbanization of the 1960s and 1970s, but was also influenced by the rapid changes in the agricultural structure during these years, where especially the field rationalization caused the removal of a considerable part of the so-called small biotopes from agricultural areas (described later on).

From an isolated island-theoretical point of view, the planned corridors were not necessarily the best way to secure the biodiversity of the Greater Copenhagen area. In fact an alternative proposal was set up by the conservation authorities, arguing for a buffer zone 1 km in width around the core areas, instead of dispersal corridors between them (Asbirk, 1984; Hansen-Møller, 1994). This was however rejected, mainly due to economic and political reasons: the agricultural value of the areas surrounding the core areas was too high, especially when compared to the relatively marginal character of most of the designated corridors along the watercourses. Nor could the buffer zones fulfil all the other planning objectives that could fit into the concept of 'dispersal corridors'.

Also in the County of West Zealand the planning of ecological corridors started early (Ovesen, 1984). Here the designation of dispersal corridors was mainly based on a rough interpretation of topographical maps, with emphasis on existing watercourses and the density and 'connectedness' of other types of landscape elements. No registration of flora and fauna for an interpretation of main dispersal routes for selected species was done.

In the 1983 regional plan, the corridors have been indicated with a zone 500 m in width, spreading out from the protected areas into the so-called landscape- and agricultural areas. These 'ecological

connections' are however only to be understood as an indicative line, not as an area with related restrictions on land use. There have been no changes in the location of the corridors since the first map from 1985. In practice, however, up to now very little has been done to realize the plans.

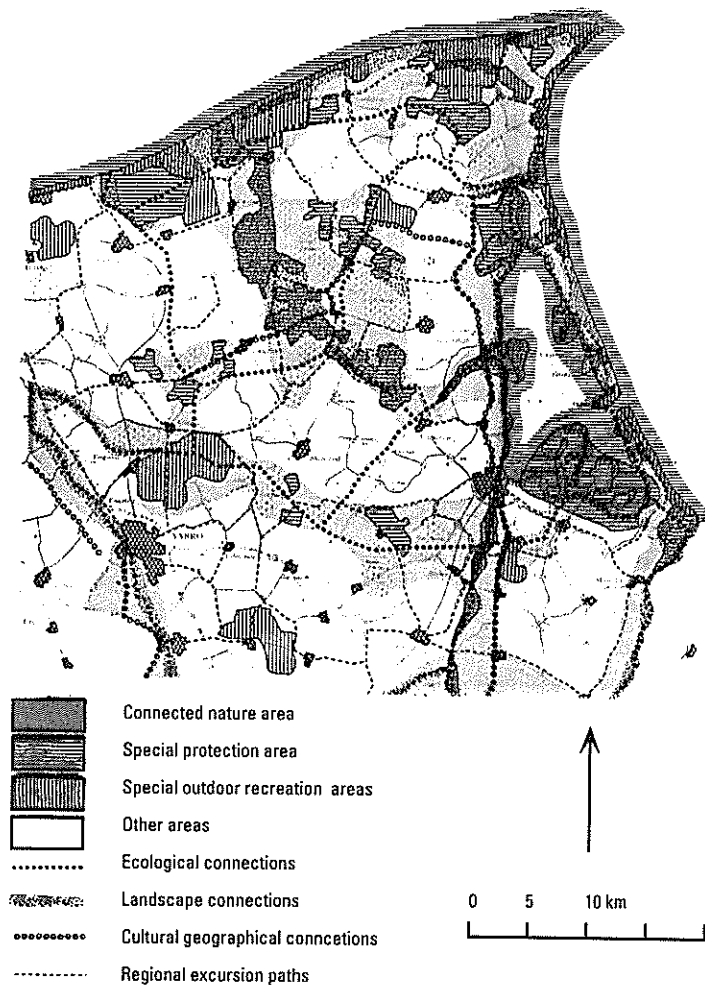
Neither in the Greater Copenhagen Region nor in West Zealand has a registration of land cover/land use within the dispersal corridors been carried out. Thus it has not been possible to make a comparison of the corridors' area structure with the surrounding landscapes or the whole county. Nor is it possible to follow the degree of realization of the corridors over time statistically.

These planning activities of the counties near Copenhagen in the beginning of the 1980s substantially influenced conservation authorities in the Ministry of Environment. In 1983 a guidance document on conservation planning was distributed to all counties, putting emphasis on the corridor planning.

Probably the most important point in this document was a map of a hypothetical structure for a hypothetical county, emphasizing the main principle of the plan, namely to designate relevant areas (continuous nature areas, special protection areas, special recreation areas, and other areas) and link these by different types of connections (ecological connections, landscape connections, and excursion roads and -paths). The different types of connections have different purposes, but are often supposed to coincide geographically, as shown in figure 4. These optional guidelines for conservation planning in the counties would obtain a binding political status only if incorporated in the integrated regional plans.

The planning of ecological networks outside Zealand

Outside Zealand, in counties not yet involved, these guidelines have been re-



• Figure 4
Part of the main structure of a hypothetical Danish county, according to the guidance document on conservation planning published by the Ministry of Environment (1983). After (Fredningsstyrelsen, 1983).

ceived in a very different way, because these counties have not yet been involved in corridor planning.

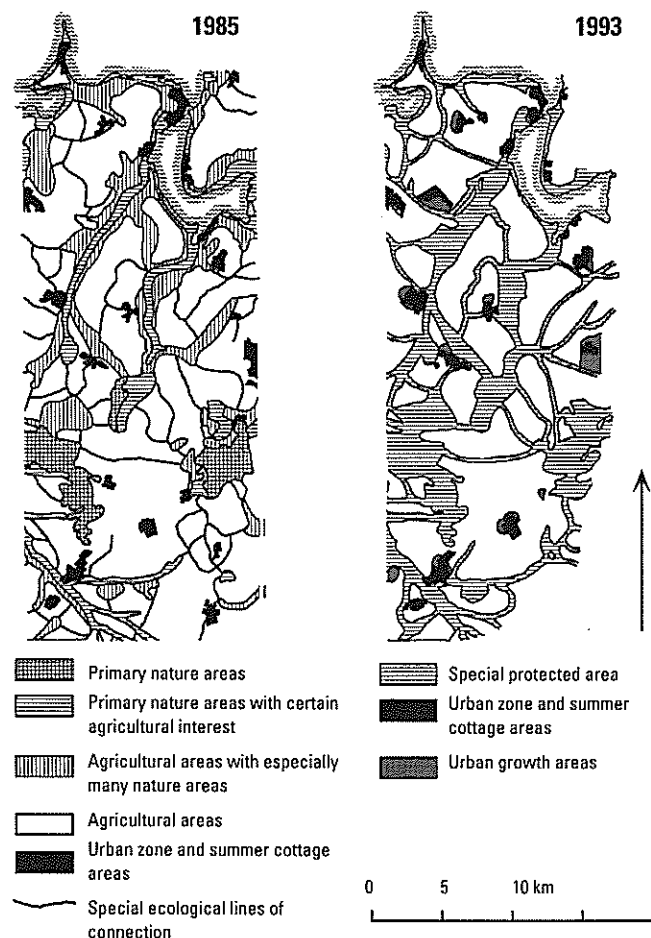
In 1985 North Jutland conservation authorities planned a rough network, and refined it over the following years, as regards both its quantity and quality, using a variety of different types of ecological connections, e.g. a wet, freshwater type, a type for salt marshes, a type for dry grassland, and a type for shrub- and tree vegetation.

In the main structure of the conservation plan, these types have been merged into a line signature. Moreover, the conservation plan has never been integrated as a politically binding part of the regional plan. In

this, different types of nature areas are identified, but no indication is made as to how they should be connected.

In the southwest part of this region (Viborg County), a different situation is found. In the 1985 regional plan, designated nature areas are often connected by areal bands with a high abundance of nature areas within the agricultural regions, as well as by line signatures for a rather dense network of ecological corridors (see figure 5).

In the 1993 plan, these structures have become even more pronounced through a new simplified area structure. It defines almost all of the former linear corridors as areal features and -more importantly-



• **Figure 5**
Ecological networks in Viborg County, according to the regional plans of 1985 and 1993. Simplification of a part of the map on areal resources.

gives them the same planning status as the core areas. They are all named 'special protected areas'. In connection with the designation of especially sensitive agricultural areas (established as a part of the 1995 EU agricultural policy), almost all of the corridors within these areas have been granted this preference status, thus giving farmers within the areas an opportunity to obtain extra EU-financed support if they implement extensification and other types of environmental improvements such as buffer zone 12 m in width along watercourses or other linear biotopes. A similar development can be seen in the South Jutland County. Only a few counties have no mention of corridor planning in their regional or con-

servation plans. Two have directly delegated the problem of dispersal ecology to the municipalities; however, municipalities seldom have the capacity to deal with the problem.

In Funens County, where as mentioned above there have been delineated 'areas of biological connection' as far back as 1980, these areas have been removed from the latest regional plan (1993), with the comment that they in practice were without importance.

The status of corridors in Danish regional planning

An overview of the status of corridors in the regional plans of Danish counties between 1980 and 1994 is given in table 1. It shows that most Danish Counties have been engaged in the planning of ecological corridors at a regional level. It also shows that most initiatives were taken between 1980 and 1985, and that rather few changes have occurred since then.

On regional planning maps, ecological corridors generally appear as significant elements. But surprisingly little documentation exists concerning the specific basis for the designation of the corridors, their specific purposes, their land cover structure, and the actual plans for their realization. Even a simple description of the designated corridors giving status, possibilities and constraints on their present and future functions is lacking in all counties.

The realization of dispersal corridors in Danish counties

Up until now very few of the planned corridors have been realized. This, though, is no surprise: the plans have been developed within the last 15 years, and since the most important measures are general constraints on or stimulation of private land-use within the planned corridors, it will certainly take some time before substantial effects may be observed.

Two of the most well-known Danish examples of the realization of ecological corri-

dors have been described by Hansen-Møller (1994)². Both are from the Greater Copenhagen Region (see figure 3). The case of Pøle River was a test area for the discussion of the use of dispersal ecology in conservation planning (Asbirk & Jensen, 1984). Substantial support for the restoration and construction of wetlands along the river has been given by the Ministry of Environment, according to the Nature Protection Act (Skov- og Naturstyrelsen, 1992). The main motivation for these measures has however not been to enhance the possibilities of dispersal along the river, but rather to improve the water quality as a part of an ambitious plan for the purification of Arresø, the largest lake in Zealand. In the case of Ejby River, measures have been taken to improve the living conditions for the European spadefoot (*Pelobates fuscus*) and green toad (*Bufo viridis*) through the creation of small ponds within the corridor. But similar measures can be seen in other areas, where they generally have been implemented at the local level, totally independently from the region planning of dispersal corridors (although done by the same authorities). In these cases the measures taken can hardly be considered a result of corridor planning.

In general, it may be concluded that very little action has been taken on the regional level to implement the planned dispersal corridors. Besides lack of funds, one main reason might be the fact that regional conservation authorities are responsible for the planning and implementation of ecological corridors. Even where these authorities have been positively disposed towards the idea of dispersal corridors, in most cases they have tended to see them as unreasonable competition for their main endeavour: the protection of areas of special biological interest. In fact, in the last few years only one county (Viborg) seems to have systematically developed its planning of ecological networks and taken practical steps towards their realization.

The missing networks at national and local levels

Much experience concerning the planning of dispersal corridors has been collected at the regional level, strongly supported by the state's conservation-planning authorities.

In the light of this, it might come as a surprise that no plans for a national ecological network have yet been made, even within academic institutes. Nor has any systematic work at the local level been

County:	1980	1985	1989	1994
Greater Copenhagen Area	•••	•••••	•••••	•••••
West Zealand	•	•••••	•••••	•••••
Århus	•••	•••	•••	•••••
Bornholm	•	•••••	•••••	•••••
Viborg	•	•••••	•••••	•••••
South Jutland	•	•••	•••••	•••••
Fyn	•••	•••••	•••••	•••••
North Jutland	•••	•••	•••	•••
Vejle	•	••	••	••
Storstrøm	•	••	••	••
Ribe	•	••	••	••
Ringkøbing	•	•	•	local

• : Almost no attention paid to the dispersion of species in the regional plan
 •• : Problems of dispersal ecology are delegated to the municipal level
 ••• : Indirect attention paid to dispersion of species in the regional plan
 •••• : Dispersal corridors are indicated in the conservation plan, but have not been included in the regional plan
 ••••• : Dispersal corridors and/or bands of connections between main nature areas are indicated in the regional plan
 Local: municipalities are asked to take care of the planning of dispersal corridors on the detailed, local level.

• **Table 1**
The status of corridors in Danish regional planning. It relates only to official plans, not to the status of implementation. Sources: Regional and conservation plans for the Danish Counties between 1980 and 1994

Table 2 •
The history of general, non-compensated protective measures for biotopes in the Danish agricultural landscape according to the Nature Conservation Act (1937, 1972, 1978, 1984 par. 43) and the Nature Protection Act (1992 par. 3,4 and 12) (Min. size in m²).

	1937	1972	1978	1984	1992
Barrows	all	all	all	all	all + 2 m buffer zones
Other archaeological sites					most types + 2 m buffer zones
Water courses		> 1.5 m	> 1.5 m + specially selected	> 1.5 m + specially selected	high priority + 2 m buffer zones
Lakes and ponds		all natural lakes	all lakes > 1 000	all lakes > 500	all lakes > 100
Bogs			> 5 000	> 5 000	> 2 500
Heaths			> 50 000	> 50 000	> 2 500
Salt meadows			> 30 000	> 30 000	> 2 500
Fresh meadows			> 2 500	> 2 500	> 2 500
Dry pastures			> 2 500	> 2 500	> 2 500
Stone and earth dikes					all on topographical maps (provisionally) + 2 m buffer zones

undertaken, with the exception of a few experiments (Skov- og Naturstyrelsen, 1992). Although it is difficult to find reasonable explanations for this situation, the following factors might be of importance. Due to the archipelago character of eastern Denmark, which occupies 1/3 of the land surface, a nationally-coordinated ecological network can be seen as something relevant only to Jutland. However, other reasons can be mentioned as well, e.g. the position of the agricultural sector in Denmark, which traditionally is the strongest, most well-organised and efficient economic lobby within Danish society. In 1970 a fundamental law divided Denmark into three zones (rural-, urban-, and 'weekend cottage' zones), not only restricting all types of urban development to the urban zones, but keeping the rural zone basically for agricultural purposes. Up until just a few years ago, this law and the philosophy behind it had been applied very strictly by the authorities on all levels. Of course, conservation interests in the rural zones have been taken into account, but defining national corridors connecting main

types of habitats and landscape would have resulted in specific restrictions in free agricultural land-use, and probably would have been contradicted both the zoning laws and the idea of free enterprise for farmers within the rural zone. It proved to be politically easier to leave such initiatives to regional planners. At the same time, local interests in countryside planning has been restricted by taking this field of planning out of the hands of the municipalities, and leaving it to the county authorities.

Another explanation can be found within the development of conservation planning itself. During the 1970s there was a serious conflict in Denmark concerning the choice of a conservation strategy. The rapid economic growth increased pressure on land use at all levels, and many wildlife habitats disappeared, especially due to the intensification of agriculture (Agger & Brandt, 1988; Brandt, 1991). Was the answer to give priority to national parks, which include the most important nature interests? Or should improvements be made on a general level, trying to preserve

as much nature as possible, also in the more intensively used agricultural areas? In other words, should it be a segregation or an integration model? (Van Lier & Cook, 1994) The last strategy has won. There are no national parks in Denmark, and although the purpose would have been something quite different, the designation and realization of a national network of corridors would have been a concentrated effort like national parks, drawing attention away from the 'ordinary' but threatened types of nature in the agricultural landscape.

Although one might argue that an ecological network at a national level is of minor importance, it could however stimulate regional planning by setting up priorities for the realization of regional networks. Up until now counties seem to have given a low priority in general to the realization of designated corridors. A designation of a national ecological network might put pressure on regional authorities to take serious measures for the realization of at least parts of the regional networks, in close cooperation with the central planning authorities. It could also stimulate a closer cooperation between counties concerning the planning and realization of the networks.

Perspectives for the development of ecological networks at regional and local levels.

Instead of national parks, Denmark now has -as well as its nature conservation areas- a refined system of mild, general protective measures: restrictions on free land-use, without economic compensation, that makes it illegal to alter certain types of nature (Table 2).

The table shows how these general protective measures have been developed. From a culturally based protective system of barrows from the bronze and iron ages, more and more natural elements have been added to the list. In addition, the minimum size of these elements regulated by law has also been lowered considerably.

Especially the 1992 Nature Protection Act is focusing on the importance of the so-called small biotopes, tiny nature elements within and between the fields in the countryside, such as stone- and earth dikes, small bogs, heaths, meadows and commons (down to a quarter of a hectare), and small ponds (down to 100 m in width) (see also Koester, 1994). This tendency was already seen in regional planning at the beginning of the 1980s, when the Ministry of Environment in connection with the approval of regional plans asked counties to make recommendations expressing the wish to secure the remaining small biotopes in the open land, such as hedgerows, small bogs and ponds.

The widespread interest in the small biotopes among the general public, supported by the general protective measures and by campaigns among farmers focusing on the importance for wildlife, scenery and game, has obviously influenced the thinking and practice of many farmers. The marked tendency of reduction in the amount of small biotopes that had been observed especially since the 1960s, was generally halted during the 1980s, when a net increase in the density of hedgerows, game plantations, open ditches and small ponds occurred, especially in the western part of Denmark (Table 3).

Certainly this tendency has also been strongly supported by internal agricultural factors, such as the reintroduction of proper field-rotation, changes in the EU price system, etc., supporting a general extensification of agricultural land use. But the growing focus on small biotopes has added to a growing recognition among farmers of the benefits to be gained from a balanced and multiple use of land, rather than using it only as a medium for intensive agricultural production.

This positive development should also be related to the general situation for wildlife in Denmark. In a book on Danish flora and fauna (Asbirk & Sogaard, 1991), out of 9,360 species investigated 3,176 in differ-

Table 3 •
Table showing the development of small biotopes in Denmark in 1981-91.

Development of small biotopes in Denmark 1981 - 1991		1981-86' (% per year)	1986-91 (% per year)	Wet linear biotopes	Dry linear biotopes
13 Test sites in Eastern Denmark (52 km ²)	Wet linear	-0.1	-1.1	Drainage ditch	Road verge
	Dry linear	-0.1	+0.2	Canal	Field divide
	All linear	-0.1	0.0	Brook	Hedgerow
10 Test sites in Eastern Jutland (40 km ²)	Wet areal	-1.8	-0.8	River	Slope
	Dry areal	+0.9	+2.0		Railway dike
	All areal	-0.6	+0.6		Tree row
25 Test sites in Denmark** (100 km ²)	Wet linear		+3.2		Stone wall
	Dry linear		0.0		Footpath
	All linear		+0.4	Wet areal biotopes	Dry areal biotopes
	Wet areal		+2.4	Wet Marl pit	Dry Marl pit
	Dry areal		+4.7	Other wet pit	Other dry pit
	All areal		+3.7	Artificial pond	Barrow
				Bog	Game plantation
	Wet linear		+0.3	Natural lake	Other plantation
	Dry linear		0.0	Village pond	Natural thicket
	All linear		+0.1	Alder swamp	Solitary tree
	Wet areal		+0.3	Rain water basin	Ruderal area
	Dry areal		+2.6		High power mast
	All areal		+1.5		

* Indicated as % annual change in average for all test sites; the linear in % of length; the areal in % of number.

** Including two test sites on Bornholm in the Baltic Sea

ent threatened categories are listed. About half of these threatened species have forests as their main habitat, and the majority of the rest moors, coastlines, heaths or dry pastures.

Although the threats should be related to changes in land use and environmental factors (and especially to intensification and 'monotonization' within forestry and agriculture), problems of dispersal ecology have to be taken into account, too. Due to the low acreage of these main habitats (forest 11%, moor 1%, heath and dry pastures 2%) and their widespread fragmentation, the character of agricultural land, which covers 2/3 of the total acreage, is of major importance for the dispersal of species and the maintenance of metapopulations. Further, about 1/3 of the total area with permanent vegetation are habitats linked to the agricultural landscape as small, mainly man-made biotopes within and between the fields, of which a part is now under general protection.

The policy of general protection might have a profound influence on the development of strategies for ecological networks in Denmark. In 1994-95 substantial resources have been used for the biotope registration according to the new nature protection law. This registration can form a powerful tool not only for refined plans for ecological networks on the regional level, but also and especially for the concrete planning of integrated land-use on the local level.

Strangely enough, however, no trace of this perspective is to be found within the activities of contemporary conservation planning within in the Danish counties or the Ministry of Environment. Obviously the main obstacles for such a development seem to be organizational. Setting up ecological networks in already intensively-used agricultural landscapes is seldom just a question of conservation, but rather a matter of active nature restoration at a modest level, i.e. the design of hedgerow

networks, the creation of tiny buffer zones, the (re)establishment of small ponds in moist hollows, and of game- and other plantations around former marl pits, spots with bad soil conditions or a more or less marked slope topography. All in all, a variety of small measures that over time could stimulate the formation of functional ecological networks at the local level, especially if they are closely connected to extensification measures within agricultural planning (Brandt, 1994; Brandt, Holmes & Larsen, 1994).

This would presuppose a strong coordination of the different interests related to network planning at local level. Obviously the Danish system for countryside planning is not yet geared towards a support of such a local and broad integrated strategy. However, within the existing system the situation could be improved considerably by rather simple measures, especially by:

- Procedures for a technical description of the corridors, including an evaluation of the different sorts of functionality related to and expected from the corridors, and including land use/land cover statistics for the systematic monitoring of the long-term trends within and outside the corridors, and

- A procedure for a systematic evaluation and follow-up of the implementation of the plans based on a better coordination of the different departments directly and indirectly engaged in the planning related to the corridors.

Summary

Ecological networks in Danish Planning
J. Brandt
Landschap 12/3

The planning of ecological networks has developed in Denmark since the 1970s mainly at the regional level, related to the responsibility of the counties for regional and countryside planning. About half of the counties have followed the recommendation from the central conservation authorities to set up plans for ec-

ological networks including designation of ecological connections. Very few counties, however, have seriously been working on a realization of the planned networks. This can be related to a lack of network planning at the national level, that could put pressure on and guide the counties in setting up a priority for regional networks. It could also stimulate coordination with other counties. A fine base for the planning of local networks is given through the development of a general conservation strategy, that has initiated a detailed registration of a variety of important landscape elements. But up until now, no procedures for the systematic promotion of such local networks has been developed.

Literature

- Agger, P., & J. Brandt, 1984. Forvaltning af biotopmonstre. In P. Løjtnant (ed.), *Spredningsøkologi* (pp. 63-67). København: Naturfredningsrådet og Fredningsstyrelsen.
- Agger, P. & J. Brandt, 1988. Dynamics of small biotopes in Danish agricultural landscapes. *Landscape Ecology*, pp. 227-240.
- Asbirk, S. 1984. Elaboration of Dispersal Corridors And Zones. In B. Løjtnant (ed.), *Spredningsøkologi* (Dispersal Ecology) (pp. 33-38). Copenhagen: Naturfredningsrådet og Fredningsstyrelsen.
- Asbirk, S. & S.M. Jensen, 1984. An Example of Applied Island Theory and dispersal biology. In B. Løjtnant (ed.), *Spredningsøkologi* (Dispersal Ecology) (pp. 49-55). København: Naturfredningsrådet og Fredningsstyrelsen.
- Asbirk, S. & S. Søgaard, 1991. 'Rødliste 90'. Særligt beskyttelseskrævende planter og dyr i Danmark. Hørsholm: Skov- og Naturstyrelsen.
- Baudry, J. & G. Merriam, 1988. Connectivity and connectedness: Functional versus structural patterns in landscapes. In K-F. Schreiber (ed.), *Connectivity in landscape ecology* (pp. 23-28). Münster, FRG: K-H. Schreiber.
- Bennett, G. (ed.), 1991. Towards a European Ecological Network - EECNET. Institute for European Environmental Policy.
- Bischoff, N.T. & R.H.G. Jongman, 1993. Development of Rural Areas in Europe: The Claim for Nature. Netherlands Scientific Council for Government Policy Preliminary Report V79, SDU, The Hague.
- Brandt, J., 1991. Land use, landscape structure and the dynamics of habitat networks in Danish agricultural landscapes. In J. Baudry, F. Burel, & V. Hawrylenko (ed.), *Comparisons of landscape pattern dynamics in European rural areas. 1991 Seminars* (pp. 213-229). Ukraine, Normandy: French and Ukrainian MAB Committee, UNESCO.
- Brandt, J., 1994. Småbiotopernes udvikling i 1980'erne og deres

fremtidige status i det åbne land. In J. Brandt & J. Primdahl (eds.), *Marginaljorder og landskabet - marginaliseringsdebatten 10 år efter* (pp. 21-49). København: FSF. Forskningsserien.

Brandt, J., E. Holmes & D. Larsen, 1994. Monitoring 'small biotopes'. In F. Klijn (ed.), *Ecosystem Classification for Environmental Management* (pp. 251-274). Dordrecht: Kluwer academic publishers.

Forman, R.T. & M. Godron, 1986. *Landscape Ecology*. New York: John Wiley & Sons.

Fredningsstyrelsen, 1979. *Naturfredningsloven. Ændringer i 1978*. København: Fredningsstyrelsen.

Fredningsstyrelsen, 1983. *Vejledning i fredningsplanlægning nr. 3*. København: Fredningsstyrelsen. Miljøministeriet.

Hansen-Møller, J., 1994. Recreation, reproduction and ecological restoration in the Greater Copenhagen region. In W. A. Cook & H. N. v. Lier (eds.), *Landscape planning and ecological networks* (pp. 225-248). Amsterdam: Elsevier.

Harms, W.B. & P. Opdam, 1990. Woods as habitat patches for birds: application in landscape planning in the Netherlands. In I. S. Zonneveld & R. T. T. Forman (eds.), *Changing Landscapes: An Ecological Perspective* (pp. 73-97). New York: Springer-Verlag.

Hovedstadsrådet, 1982. Forslag til udpegning af fredningsinteressesområder (Planlægningsdokument No. PD 354). Hovedstadsrådet.

Koester, V., 1994. General Protection of Natural Habitats in Denmark: Evolution and Perspectives. In A. Kiss & F. Burhenne-Guilmin (eds.), *A Law for the Environment: Essays in Honour of Wolfgang E. Burhenne* (pp. 231-241). Gland, Switzerland; Cambridge, UK: EPLP Special Issue.

Langevelde, F.V., 1994. Conceptual integration of landscape planning and landscape ecology, with a focus on the Netherlands. In W. A. Cook & H. N. v. Lier (eds.), *Landscape planning and ecological networks* (pp. 27-69). Amsterdam: Elsevier.

Lewis, P.H., 1964. Quality corridors for Wisconsin. *Landscape Architecture* (January) (pp. 100-107).

Lier, H. van & E. Cook, 1994. Ecological networks: a conspectus. In W. A. Cook & H. N. v. Lier (eds.), *Landscape planning and ecological networks* (pp. 327-346). Amsterdam: Elsevier.

MacArthur, R.H. & E.O. Wilson, 1967. *The theory of island biogeography*. Princeton University Press, Princeton.

Mander, Ü., J. Jagomägi, & M. Külvik, 1988. Network of compensative areas as an ecological infrastructure of territories. In K.F. Schreiber (ed.), *Connectivity in Landscape Ecology*. Proc. 2nd Int. IALE Seminar. Münstersche geographische Arbeiten (pp. 35-38).

McHarg, I.L., 1969. *Design with Nature*. NY: Doubleday, Garden City.

Miklos, L., 1991a. Conception of territorial system of ecological stability, nature protection, biodiversity and gene pool maintenance No. Slovak commission for Environment.

Miklos, L., 1991b. Proposal for the program of the IALE Working Group 'Landscapeecological planning'. *IALE Bulletin*, 9(4), pp. 6-8.

Miklos, L., 1994. *Spatial Organization of the Landscape* (Research

Report No. 103). Department of Geography and International Development studies. Roskilde University.

Miljøstyrelsen, 1994. *Vandløbene - ti år med den nye vandløbslov* (Miljønyt No. 10). Miljøministeriet Miljøstyrelsen.

Muus, B.J., 1981. *Økologiske love og fredningsplanlægning*. København: Naturfredningsrådet.

Opdam, P., 1991. Metapopulation theory and habitat fragmentation: a review of hoartic breeding bird studies. *Landscape Ecology*, 4, pp. 94-106.

Ovesen, C.H., 1984. Ecological Connections - an Example from the County of west Zealand. In B. Løjtnant (ed.), *Spredningsøkologi (Dispersal Ecology)* (pp. 43-48). Copenhagen: Naturfredningsrådet og Fredningsstyrelsen.

Skov- og Naturstyrelsen (ed.), 1992. *Naturforvaltning 1989-1990* (1 ed.). Helsingør: Skov- og Naturstyrelsen.

Zonneveld, I., 1994. Landscape ecology and ecological networks. In W. A. Cook & H. N. van Lier (eds.), *Landscape planning and ecological networks* (pp. 13-26). Amsterdam: Elsevier.

Nordjyllands Amt: Regional plans, 1982, 1986, 1990, 1994
 Nordjyllands Amt: Conservation Plans, 1982, 1984, 1987
 Viborg Amt: Regional plans, 1980, 1985, 1989, 1993
 Viborg Amt: Conservation plans 1989
 Ringkøbing Amt: Regional plans, 1979, 1985, 1989, 1993
 Ringkøbing Amt: Conservation plans, 1985, 1991
 Århus Amt: Regional plans, 1980, 1985, 1989, 1993
 Århus Amt: Conservation plan 1984
 Vejle Amt: Regional plans, 1980, 1985, 1989, 1993
 Vejle Amt: Conservation plan 1985
 Ribe Amt: Regional plans, 1980, 1985, 1989, 1993
 Sønderjyllands Amt: Regional plans, 1979, 1983, 1985-86, 1994
 Sønderjyllands Amt: Conservation plan 1987
 Fyns Amt: Regional plans, 1980, 1985, 1989, 1993
 Fyns Amt: Conservation plans 1975, 1983, 1991
 Bornholms Amt: Regional plans, 1977, 1985, 1989, 1993
 Bornholms Amt: Conservation plan 1985
 Storstrøms Amt: Regional plans, 1980, 1985, 1993
 Storstrøms Amt: Conservation plans 1976, 1990
 Vestsjællands Amt: Regional plans 1980, 1985, 1989, 1993
 Vestsjællands Amt Hvidbog 1993
 Roskilde Amt: Regional plan 1993
 Frederiksborg Amt: Regional plan 1993
 Københavns Amt: Regional plan 1993
 Hovedstadsrådet: Regional plans 1973, 1989

¹ Personal communication with Sten Asbirk, former conservation planner in the Council of the Greater Copenhagen area

² Unfortunately the two maps of the described corridors in this publication (figure 11.5 and 11.6 had been changed about in the layout process.

The Dutch ecological network

Erik van Zadelhoff & Wim Lammers

The Dutch Parliament approved the Nature Policy Plan in 1990. The keynote of this policy plan is the development of a National Ecological Network (NEN) within the next 20-30 years. This paper describes the development and realization of the network.

Introduction

The Netherlands have lost a great part of their natural wealth over the last centuries. Nature conservation efforts by both private organisations and the government could not prevent the decline of nature. The following data illustrate the deterioration.

Between 1930 and 1990, some 500 of the 1,400 species of flowering plants in the Netherlands declined in number, and 70 species disappeared. During the same period, more than 50% of the butterfly species were reduced in number. Figure 1 gives an overall picture of the developments.

The loss of nature values has a number of causes, most of which have been known for some time. The most important factors are loss of habitats, fragmentation of the remaining nature areas, and environmental problems in this prosperous and densely populated country.

Soil-, water- and air pollution cause not only the local disturbance of species and habitats; it has become more and more

clear that they have a widespread and diffuse influence via atmospheric depositions and surface- and groundwater movements. At the end of the 1980s, environmental issues were attracting a lot of attention. There was a common awareness that the negative trend had to be stopped by a combined effort of government and non-governmental organisations and individuals. In 1990 the Dutch parliament accepted a set of environmental plans: the National Environmental Policy Plan, the Third National Policy Document on Water Management, and the Nature Policy Plan. With the Nature Policy Plan (Ministerie van LNV, 1990), the Dutch government plans to counterbalance the deterioration of nature by presenting a new strategy for its conservation.

A new strategy for nature conservation

Nature conservation in the traditional way means action in reaction, giving rise to the image of always telling what is not allowed, with the status quo as the best possible result. This traditional form of nature conservation often discusses problems in their local context only, without appealing to the (inter)national significance of the ecological characteristics of the area.

The Nature Policy Plan tries to break with this image by paying attention to opportunities rather than just problems, by setting clear priorities in an (inter)national context, and by presenting sustainable solutions.

Nature Policy Plan

National Ecological Network

Nature conservation

Landscape ecology

The Netherlands

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